A CFD study on the effect of membrane permeance on permeate flux enhancement generated by unsteady slip velocity

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ABSTRACT

One of the most noteworthy achievements in reverse osmosis (RO) efficiency is the improvement in membrane permeance. Although current membranes offer higher permeance (and flux) than older RO membranes, increases in permeate flux are limited by concentration polarisation (CP) and fouling. Therefore, innovation is needed to reduce CP to further increase permeate flux. An unsteady forced slip velocity can disrupt the boundary layer, thus reducing CP. This paper uses Computational Fluid Dynamics (CFD) to analyse the effect of membrane permeance on the resonant frequency for an unsteady forced slip velocity, as well as the resulting mass transfer enhancement. The results show that the resonant frequency of the unsteady forced slip velocity is not affected by the membrane permeance. Although the results show a peak in the mass transfer enhancement factor for permeance values in the range typically used for brackish water, the permeate flux can also be improved for higher membrane permeances (up to 23%) at the expense of a slightly higher pumping.

KEYWORDS: CFD; Forced slip velocity; Permeance; Permeate flux enhancement; Concentration polarisation

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